

Product Specification of PDP Module

CUSTOMER APPROVAL SPECIFICATION

Title	PDP50X4#### (50" WXGA PDP MODULE)
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Buyer Name	Dong Bang	Supplier	LG Electronics Inc.
Model Name		Model Name	50X4
PART No.		PART No.	

Signature / Date	
Approved by	
Please return 1 copy for our confirmation With your signature	

Signature / Date	
Approved by	
PDP Engineering Department PDP Division LG Electronics Inc.	

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Product Specification of PDP Module**Record of Revisions**

Revision No.	Effective Date	Comments

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Product Specification of PDP Module

0. Warnings and Cautions

- ✓ WARNING indicates hazards that may lead to death or injury if ignored.
- ✓ CAUTION indicates hazards that may lead to injury or damage to property if ignored.



- 1) This product uses a high voltage (450 V max.). Do not touch the circuitry of this product with your hands when power is supplied to the product or immediately after turning off the power. Be sure to confirm that the voltage is dropped to a sufficiently low level.
- 2) Do not supply a voltage higher than that specified to this product. This may damage the product and may cause a fire.
- 3) Do not use this product in locations where the humidity is extremely high, where it may be splashed with water, or where flammable materials surround it. Do not install or use the product in a location that does not satisfy the specified environmental conditions. This may damage the product and may cause a fire.
- 4) If a foreign substance (such as water, metal, or liquid) gets inside the product, immediately turn off the power. Continuing to use the products it may cause fire or electric shock.
- 5) If the product emits smoke, an abnormal smell, or makes an abnormal sound, immediately turn off the power. If noting is displayed or if the display goes out during use, immediately turn off the power. Continuing to use the product as it is may cause fire or electric shock.
- 6) Do not disconnect or connect the connector while power to the product is on. It takes some time for the voltage to drop to a sufficiently low level after the power has been turned off. Confirm that the voltage has dropped to a safe level before disconnecting or connecting the connector. Otherwise, this may cause fire, electric shock, or malfunction.
- 7) Do not pull out or insert the power cable from/to an outlet with wet hands. It may cause electric shock.
- 8) Do not damage or modify the power cable. It may cause fire or electric shock.
- 9) If the power cable is damaged, or if the connector is loose, do not use the product; otherwise, this can lead to fire or electric shock.
- 10) If the power connector or the connector of the power cable becomes dirty or dusty, wipe it with a dry cloth. Otherwise, this can lead to fire.

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□ General

- 1) Do not place this product in a location that is subject to heavy vibration, or on an unstable surface such as an inclined surface. The product may fall off or fall over, causing injuries.
- 2) When moving the product, be sure to turn off the power and disconnect all the cables. While moving the product, watch your step. The product may be dropped or fall, leading to injuries of electric shock.
- 3) Do not place this product in a location that is subject to heavy vibration, or on an unstable surface such as an inclined surface. The product may fall off or fall over, causing injuries.
- 4) Before disconnecting cable from the product, be sure to turn off the power. Be sure to hold the connector when disconnecting cables. Pulling a cable with excessive force may cause the core of the cable to be exposed or break the cable, and this can lead to fire or electric shock.
- 5) This product should be moved by two or more persons. If one person attempts to carry this product alone, he/she may be injured.
- 6) This product contains glass. The glass may break, causing injuries, if shock, vibration, heat, or distortion is applied to the product.
- 7) The temperature of the glass surface of the display may rise to 80°C or more depending on the conditions of use. If you touch the glass inadvertently, you may be burned.
- 8) Do not poke or strike the glass surface of the display with a hard object. The glass may break or be scratched. If the glass breaks, you may be injured.
- 9) If you glass surface of the display breaks or is scratched, do not touch the broken pieces or the scratches with bare hands. You may be injured.
- 10) Do not place an object on the glass surface of the display. The glass may break or be scratched.

□ Design

- 1) This product may be damaged if it is subject to excessive stresses (such as excessive voltage, current, or temperature). The absolute maximum ratings specify the limits of these stresses, and system design must ensure that none of the absolute maximum ratings are exceeded.
- 2) The recommended operating conditions are conditions in which the normal operation of this product is guaranteed. All the rated values of the electrical specifications are guaranteed within these conditions. Always use the product within the range of the recommended operating conditions. Otherwise, the reliability of the product may be degraded. Use of the product with a combination of parameters, conditions, or logic not specified in the specifications of this product is not guaranteed. If intending to use the product in such a way, be sure to consult LGE in advance.
- 3) This product emits near infrared rays (800 to 1000nm) that may cause the remote controllers of other electric products to malfunction. To avoid this, use an infrared absorption filter and thoroughly evaluate the system and environment.

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Product Specification of PDP Module

□ Design (continued)

- 4) This product uses high-voltage switching and a high –speed clock. A system using this product should be designed so that it does not affect the other systems, and should be thoroughly evaluated.
- 5) **The materials which contain sulfur are forbidden to use, because they may damage PDP module.**
- 6) This product has a glass display surface. Design your system so that excessive shock and load are not applied to the glass. Exercise care that the vent at the corner of the glass panel is not damaged. If the glass panel or vent is damaged, the product is inoperable.
- 7) There are some exposed components on the rear panel of this product. Touching these components may cause an electric shock.
- 8) This product uses a high voltage. Design your system so that any residual voltage in this product is dissipated quickly when power is turned off, observing the specifications.
- 9) This product uses heat-emitting components. Take the heat emitted by these components into consideration when designing your system. If the product is used outside the specified temperature range, it may malfunction.
- 10) This product uses a high voltage and, because of its compact design, components are densely mounted on the circuit board. If dust collects on these components, it can cause short-circuiting between the pins of the components and moisture can cause the insulation between the components to break down, causing the product to malfunction.
- 11) Regulations and standards on safety and electromagnetic interference differ depending on the country. Design your system in compliance with the regulations and standards of the country for which your system is intended.
- 12) To obtain approval under certain safety standards (such as UL and EN), a filter that passes a shock test must be fitted over the glass surface of the finished product. In addition, it must be confirmed that the level of UV emissions is within the range specified by such standards.
- 13) If this product is used as a display board to display a static image, “image sticking” occurs. This means that the luminance of areas of the display that remain lit for a long time drops compared with the luminance of areas that are lit for a shorter time, causing uneven luminance across the display. The degree to which this occurs is in proportion to the luminance at which the display is used. To prevent this phenomenon, therefore, avoid static images as much as possible and design your system so that it is used at a low luminance, by reducing signal level difference between bright area and less bright area through signal processing.
- 14) Within the warranty period, general faults that occur due to defects in components such as ICs will be rectified by LGE without charge. However, IMAGE STICKING is not included in the warranty. Repairs due to the other faults may be charged for depending on responsibility for the faults.
- 15) In case of AC PDP driving mechanism, Because the brightness of output is not always proportional to input signals. Therefore the non-linearity of gray can occasionally be observed in certain gray levels as well as Contour and Error Diffusion Noise can be appeared when a dark picture is on the screen especially. These are phenomena that can be observed on the PDP driving mechanism. With simple adjustment to picture brightness control, these can be reduced considerably.
- 16) Because of the need to control the power consumption on the PDP driving mechanism, the APL(Average Picture Level) mode was equipped. Thus, as the picture on the screen changes, there can be slightly switched in brightness. This also is a phenomenon that can be observed on the PDP driving mechanism.
- 17) This product is designed to LGE’s “Standard” quality grade. If you wish to use the product for applications outside the scope of the “Standard” quality grade, be sure to consult LGE in advance to assess the technological feasibility before starting to design your system.

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Product Specification of PDP Module

☐ USE

- 1) Because this product uses a high voltage, connecting or disconnecting the connectors while power is supplied to the product may cause malfunctioning. Never connect or disconnect the connectors while the power is on. Immediately after power has been turned off, a residual voltage remains in the product. Be sure to confirm that the voltage has dropped to a sufficiently low level.
- 2) Watching the display for a long time can tire the eyes. Take a break at appropriate intervals.
- 3) PDP's brightness and contrast ratio is lower than that of the CRT. The picture is dimmer with surrounding light and better for viewing in dark condition.
- 4) Do not cover or wrap the product with a cloth or other covering while power is supplied to the product.
- 5) Before turning on power to the product, check the wiring of the product and confirm that the supply voltage is within the rated voltage range. If the wiring is wrong or if a voltage outside the rated range is applied, the product may malfunction or be damaged.
- 6) Do not store this product in a location where temperature and humidity are high. This may cause the product to malfunction. Because this product uses a discharge phenomenon, it may take time to light (operation may be delayed) when the product is used after it has been stored for a long time. In this case, it is recommended to light all cells for about 2hours (aging).
- 7) If the glass surface of the display becomes dirty, wipe it with a soft cloth moistened with a neutral detergent. Do not use acidic or alkaline liquids, or organic solvents.
- 8) Do not tilt or turn upside down while the module package is carried, the product may be damaged.
- 9) This product is made from various materials such as glass, metal, and plastic. When discarding it, be sure to contact a professional waste disposal operator.

☐ Repair and Maintenance

Because this product combines the display panel and driver circuits in a single module, it cannot be repaired or maintained at user's office or plant. Arrangements for maintenance and repair will be determined later

☐ Others

- 1) If your system requires the user to observe any particular precautions, in addition to the above warnings and cautions, include such caution and warning statements in the manual for your system.
- 2) If you have any questions concerning design, such as on housing, storage, or operating environment, consult LGE in advance.

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Product Specification of PDP Module

1. GENERAL DESCRIPTION

❑ DESCRIPTION

The PDP50X4##### is a 50-inch 16:9 color plasma display module with resolution of 1366(H) × 768(V) pixels. This is the display device which offers vivid colors with adopting AC plasma technology by LG Electronics Inc.

❑ FEATURES

High peak brightness (1,500cd/m² Typical) and high contrast ratio (15,000:1 Typical) enables user to create high performance PDP SETs.

❑ APPLICATIONS

- ✓ Public information display
- ✓ Video conference systems
- ✓ Education and training systems



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Product Specification of PDP Module

□ ELECTRICAL INTERFACE OF PLASMA DISPLAY

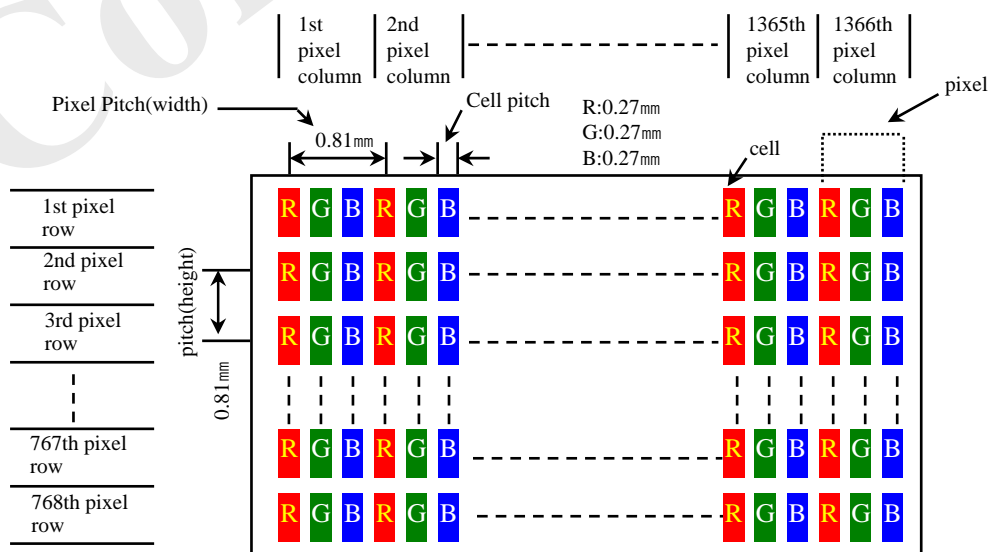
The PDP50X4#### requires only 8/10bits of digital video signals for each RGB color.
In addition to the video signals, six different DC voltages are required to operate the display.

□ GENERAL SPECIFICATIONS

- ✓ Model Name : PDP50X4#### (50X4 Model)
- ✓ Number of Pixels : 1366(H) × 768(V) (1pixel=3 RGB cells)
- ✓ Pixel Pitch : 810 μ m (H) × 810 μ m (V)
- ✓ Cell Pitch : 270 μ m (H) × 810 μ m (V) (Green Cell basis)
- ✓ Display Area : 1106.5(H) × 622.1(V) \pm 0.5mm
- ✓ Outline Dimension : 1190(H) × 700(V) × 52(D) \pm 1mm
- ✓ Pixel Type : RGB Closed(Well) type
- ✓ Number of Gradations : (R)1,024 × (G)1,024 × (B)1,024 colors
- ✓ Weight : 20.2 \pm 0.5 Kg (Net 1EA)
- ✓ Aspect Ratio : 16:9
- ✓ Peak Brightness : Typical 1,500cd/m² (1/100 White Window pattern at center)
- ✓ Contrast Ratio : Average 130:1 (In a bright room with 100Lux at center)
: Typical 15,000:1 (In a dark room 1/100 White Window pattern at center)
- ✓ Power Consumption : Max. 400 W (Full-White)
- ✓ Expected Life-time : Warranty life time 60,000 Hours with continuous operation

☞ Warranty life-time is defined as the time when the brightness level becomes half of its initial value.

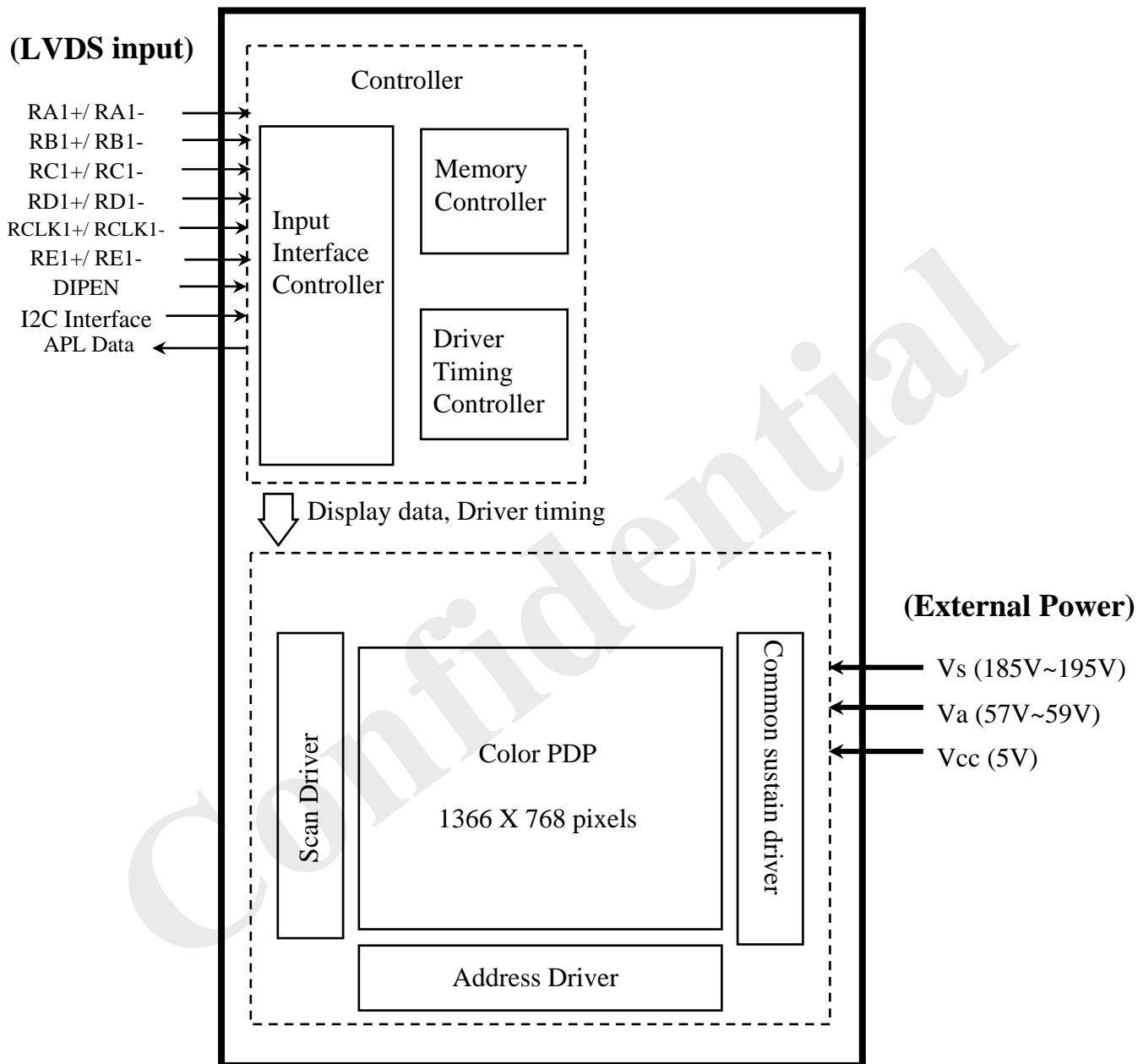
✓ Display Dot Diagram



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□ BLOCK DIAGRAM



☞ Applied Voltage level is specified at the time when Full-White pattern is displayed on the panel.

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□ CONDITIONS OF ACCEPTABILITY

1) Main Power supply

In order to supply the main power, the manufacturer of end-user products should adopt suitable Main SMPS, DC/DC Converter which are equipped with OCP and OVP.

These characteristics of OCP and OVP should be as follows.

POINT	+ 5V	V _a	V _s
OCP	26.0Arms	4.6Arms	4.3Arms
OVP	7.0Vrms	85.0Vrms	230.0Vrms

- OCP (Over current protection): This functions to protect power supply or load from output current applied in excess of limited value.
 - OVP (Over voltage protection): This functions to protect against output voltage exceeding a fixed value and against over voltage load.
-
- #### 2) Insulation
- The end-user product should satisfy the insulation and material requirements on Safety Standards of Information Technology Equipment IEC 60950, UL60950 and CSA C22.2 No60950, or IEC 60065, UL 6500 and CSA C22.2 No60065
 - The screen filter(Black mask filter) of end-user products should satisfy the supplementary insulation

3) Additional requirements

- Proper fire enclosure
- Proper mechanical enclosure
- safety test including Power Supply Board should be preformed as a part of the end-user product investigation.

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2. ELECTRICAL SPECIFICATIONS

□ Absolute Power Specifications

Item	Symbol	Condition	Min.	Max.	Unit	Remarks
Logic Voltage	Vcc	25°C	4.5	6	V	
Address Voltage	Va	25°C	-	64	V	
Sustain Voltage	Vs	25°C	-	205	V	

□ Input Power Specifications

➤ Logic Power Supply (Vcc)

Item	Condition	Min.	Typ.	Max.	Unit
Adjustable Range	-	4.75	5	5.25	V
Voltage Stability	-	-	-	± 3.0	%
Average Current	-	1.5	3.0	4.0	A _{mean}
Ripple	-	-	-	30	mV _{p-p}
Noise	-	-	-	300	mV _{p-p}

➤ Address Power Supply (Va)

Item	Condition & Remarks	Min.	Typ.	Max.	Unit
Adjustable Range	Dependent on the characteristics of each PDP	57	-	59	V
Voltage Stability	-	-	-	± 1.5	%
Average Current	Variable with the image	0.01	-	2.2	A _{mean}
Ripple & Noise	-	-	-	300	mV _{p-p}

☞ Max current of Va is measured when 2-dot on/off pattern is displayed.

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Product Specification of PDP Module

□ Input Power Specifications (Continued)

➤ Sustain Power Supply(Vs)

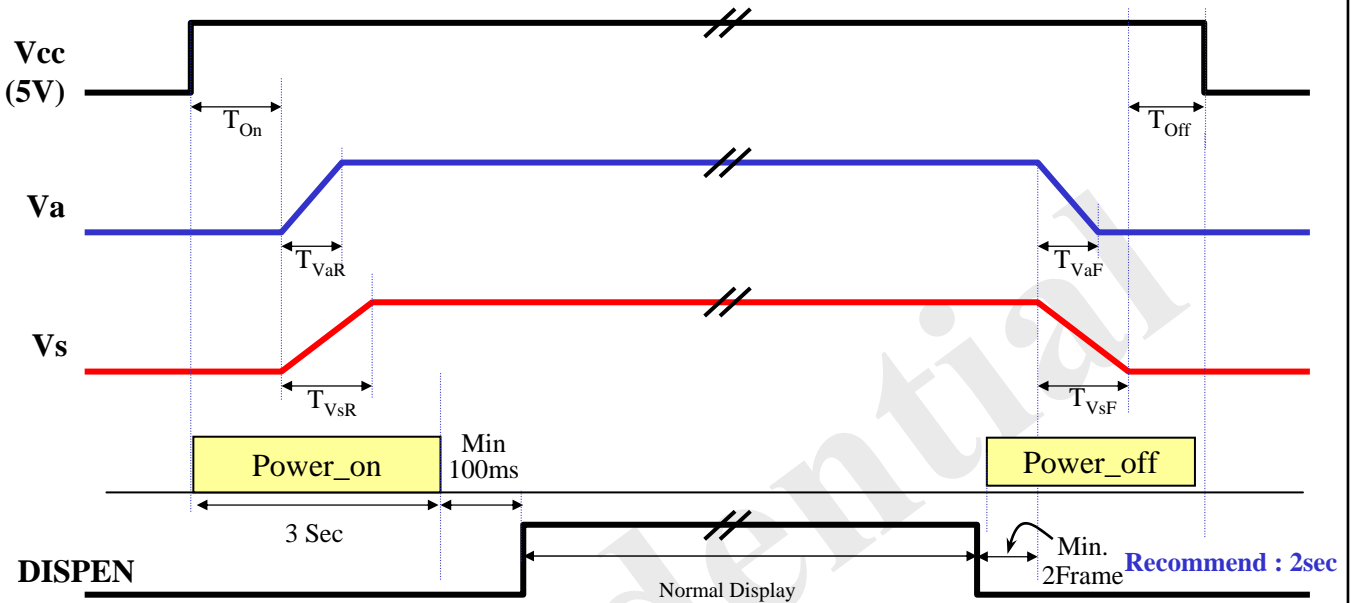
Item	Condition	Min.	Typ.	Max.	Unit
Adjustable Range	Dependent on the characteristics of each PDP	185	-	195	V
Voltage Stability	-	-	-	± 1.0	%
Peak Current	-	-	-	21	A
Average Current	Dependent on the characteristics of each PDP	0.1	-	2	A _{mean}
Voltage Regulation	At the peak current	-	-	5	V
Ripple & Noise	-	-	-	500	mVp-p

☞ Voltage should be set to a specified value which is indicated on the label attached to the module.

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□ Power Supply Sequence



Symbol	Description	Min.	Max.	unit
T _{On}	Time interval between 90% of Vcc and 10% of Vs when Power On	500	-	msec
T _{Off}	Time interval between 10% of Vs and 90% of Vcc when Power Off	20	-	msec
T _{VaR}	Rising Time of Va (10% to 90%)	10	300	msec
T _{VaF}	Falling Time of Va (90% to 10%)	50	300	msec
T _{VsR}	Rising Time of Vs (10% to 90%)	100	800	msec
T _{VsF}	Falling Time of Vs (90% to 10%)	90	500	msec
T _{on} + T _{VsR}	Time interval between 90% of Vcc and 90% of Vs when Power On	600	2000	msec

- ⚠ Vcc should be lower than 0.1V when turn on just after turn off.
- ⚠ If power sequence does not meet to above sequence diagram, PDP drivers may be damaged permanently.
- ⚠ Even when AC input power supply is switched ON/OFF, above sequence should be observed strictly.

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□ LVDS Signal and LVDS Receiver

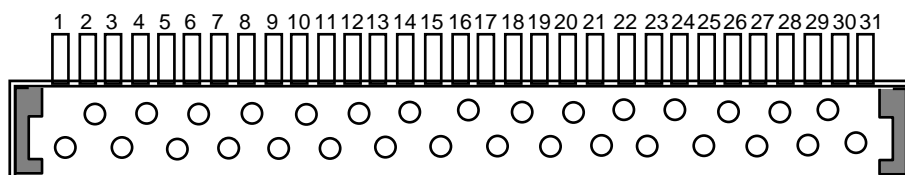
➤ Definitions and Functions of LVDS Signal

Symbol	Function and Description
RA +	Channel-A Pos. Receiver Input
RA -	Channel-A Neg. Receiver Input
RB +	Channel-B Pos. Receiver Input
RB -	Channel-B Neg. Receiver Input
RC +	Channel-C Pos. Receiver Input
RC -	Channel-C Neg. Receiver Input
RD +	Channel-D Pos. Receiver Input
RD -	Channel-D Neg. Receiver Input
RE +	Channel-E Pos. Receiver Input
RE -	Channel-E Neg. Receiver Input
RCLK +	Clock Pos. Receiver Input
RCLK -	Clock Neg. Receiver Input

➤ Video Input Connector (P1)

Connector Type : LS Cable, GT121-31P-TD

Pin No.	Symbol	Pin No.	Symbol	Pin No.	Symbol
1	GND	11	RD1-	21	Nc
2	RA1-	12	RD1+	22	Nc
3	RA1+	13	GND	23	Nc
4	RB1-	14	GND	24	RE1-
5	RB1+	15	Nc	25	RE1+
6	GND	16	Nc	26	GND
7	RC1-	17	Nc	27	DISPEN
8	RC1+	18	Nc	28	I ² C SDATA
9	RCLK1-	19	GND	29	I ² C SCLK
10	RCLK1+	20	Nc	30	Nc
				31	GND



LS Cable, GT121-31P-TD pin number (Top view)

☞ substitute : JAE, FI-TWEP31-VF

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□ LVDS Signal and LVDS Receiver (continued)

➤ Output Signals of LVDS Receiver

Symbol	Function and Description
R9 ~ R0	10-bit Red Pixel video signal (R9 : MSB, R0 : LSB)
G9 ~ G0	10-bit Green Pixel video signal (G9 : MSB, G0 : LSB)
B9 ~ B0	10-bit Blue Pixel video signal (B9 : MSB, B0 : LSB)
PIX_CLK	Clock Signal which synchronous to video signal
Vsync	vertical synchronous signal
Hsync	horizontal synchronous signal
BLANK	'HIGH' level : data is valid 'LOW' level : data is invalid
DISPEN	'HIGH' level : Display Enable 'LOW' level : Non Display

Each of the RGB signals can be changed with the Gamma Mode.

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Product Specification of PDP Module

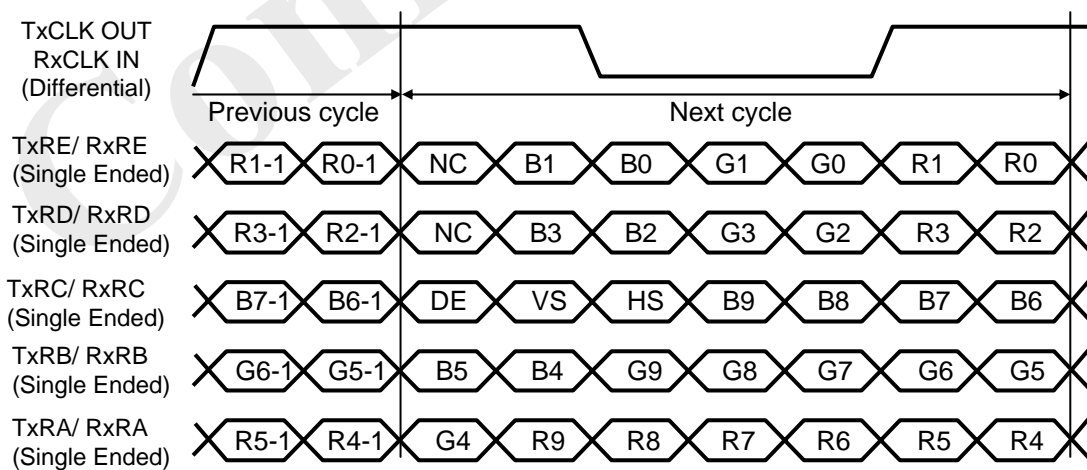
➤ Pin assignment of LVDS Receiver Output Signal

Pin No	Symbol	Pin No	Symbol	Pin No	Symbol	Pin No	Symbol
1	B9	38	G5	1	NC	38	NC
2	NC	39	G6	2	NC	39	NC
3	Hsync	41	G2	3	NC	41	G0
5	Vsync	42	G3	5	NC	42	G1
6	BLANK	43	G7	6	NC	43	NC
7	R2	45	G8	7	R0	45	NC
26	PIX_CLK	46	G9	26	NC	46	NC
27	R4	47	B4	27	NC	47	NC
29	R5	49	B2	29	NC	49	B0
30	R6	50	B3	30	NC	50	B1
32	R7	51	B5	32	NC	51	NC
33	R8	53	B6	33	NC	53	NC
34	R3	54	B7	34	R1	54	NC
35	R9	55	B8	35	NC	55	NC
37	G4			37	NC		

IC201 : First LVDS Receiver

IC202 : Second LVDS Receiver

☞ LVDS Receiver Type: THC63LVDF84B(THine)



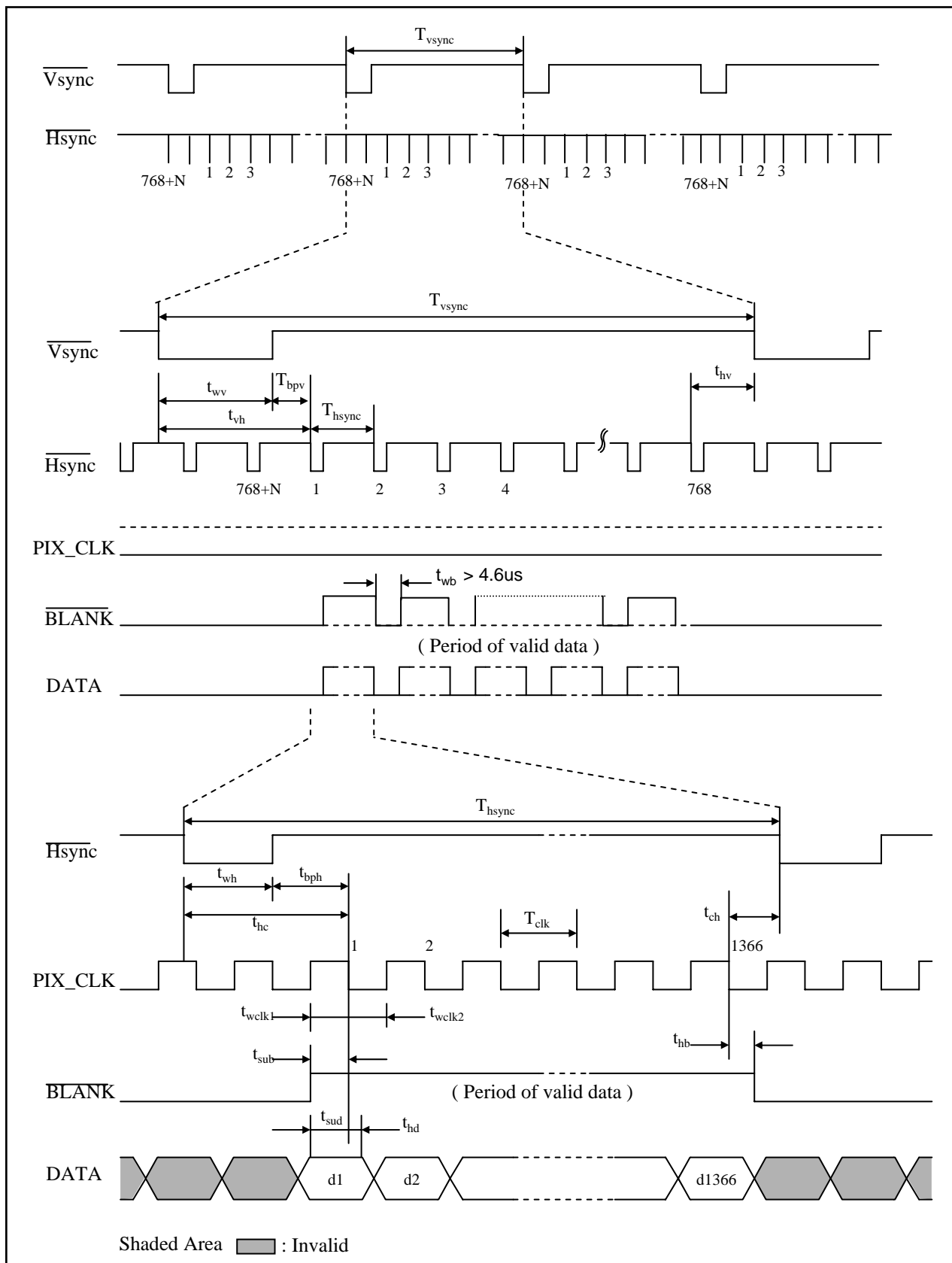
< 10-bit Data Map to LVDS outputs >

※ DE : BLANK, VS : Vsync, HS : Hsync

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□ Input Signal Timing Diagram (Non-interlaced Mode)



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□ Input Signal Timing Specification

➤ 60Hz Mode

No.	Symbol	Min.	Typ.	Max.	Unit	Remark
1	$T_{v\text{sync}}$	16.653 (801H)	16.674 (802H)	16.694 (803H)	ms (H)	1 frame (Typ.) = 59.97Hz
2	t_{wv}	187(9H)	208 (10H)	229(11H)	μs (H)	
3	t_{vh}	520(25H)	541(26H)	561(27H)	μs (H)	
4	t_{hv}		166(8H)		μs (H)	
5	T_{hsync}	20.763(1540D)	20.790(1542D)	20.831(1545D)	μs (D)	1D=13.4825ns (74.170MHz)
6	t_{wh}	0.13(10D)	0.16(12D)	0.19(14D)	μs (D)	
7	t_{hc}	1.58(118D)	1.61(120D)	1.64(122D)	μs (D)	
8	t_{ch}		0.75(56D)		μs (D)	
9	t_{clk}	13 (76.923MHz)	13.4825 (74.170MHz)	14 (71.429MHz)	ns	
10	t_{wclk1}		6.7412		ns	
11	t_{wclk2}		6.7412		ns	
12	t_{sub}		6		ns	$t_{sub} \leq t_{hc}$
13	t_{hb}		5		ns	$t_{hb} \leq t_{ch}$
14	t_{sud}		6		ns	
15	t_{hd}		5		ns	

☞ Min. & Max. of each signal is measured value when other signal is Typ.

☞ T_{hv} (Vertical Front Porch) $\geq 2H$

☞ T_{vh} (Vertical sync width + Vertical Back Porch) $\geq 15H$

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Product Specification of PDP Module

□ Input Signal Timing Specification (Continued)

➤ 50Hz Mode

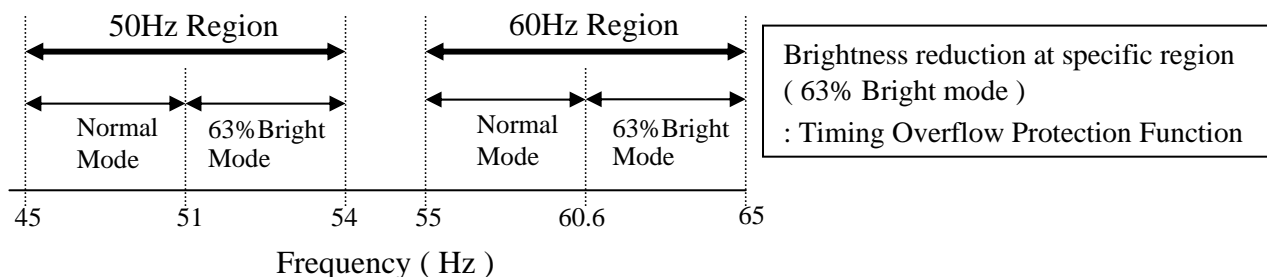
No.	Symbol	Min.	Typ.	Max.	Unit	Remark
1	T_{vsync}	19.938 (959H)	19.958 (960H)	19.979 (961H)	ms (H)	1 frame (Typ.) = 50.11Hz
2	t_{wv}	187 (9H)	208 (10H)	229 (11H)	μs (H)	
3	t_{vh}	520 (25H)	541 (26H)	561 (27H)	μs (H)	
4	t_{hv}		3.45 (166H)		ms (H)	
5	T_{hsync}	20.763(1540D)	20.790(1542D)	20.831(1545D)	μs (D)	1D=13.4825ns (74.170MHz)
6	t_{wh}	0.13(10D)	0.16(12D)	0.19(14D)	μs (D)	
7	t_{hc}	1.58 (118D)	1.61(120D)	1.63(122D)	μs (D)	
8	t_{ch}		0.75(56D)		μs (D)	
9	t_{clk}	13 (76.923MHz)	13.4825 (74.170MHz)	14 (71.429MHz)	ns	
10	t_{wclk1}		6.7412		ns	
11	t_{wclk2}		6.7412		ns	
12	t_{sub}		6		ns	$t_{sub} \leq t_{hc}$
13	t_{hb}		5		ns	$t_{hb} \leq t_{ch}$
14	t_{sud}		6		ns	
15	t_{hd}		5		ns	

☞ Min. & Max. of each signal is measured value when other signal is Typ.

☞ T_{hv} (Vertical Front Porch) $\geq 2H$

☞ T_{vh} (Vertical sync width + Vertical Back Porch) $\geq 15H$

□ Brightness Variation Function

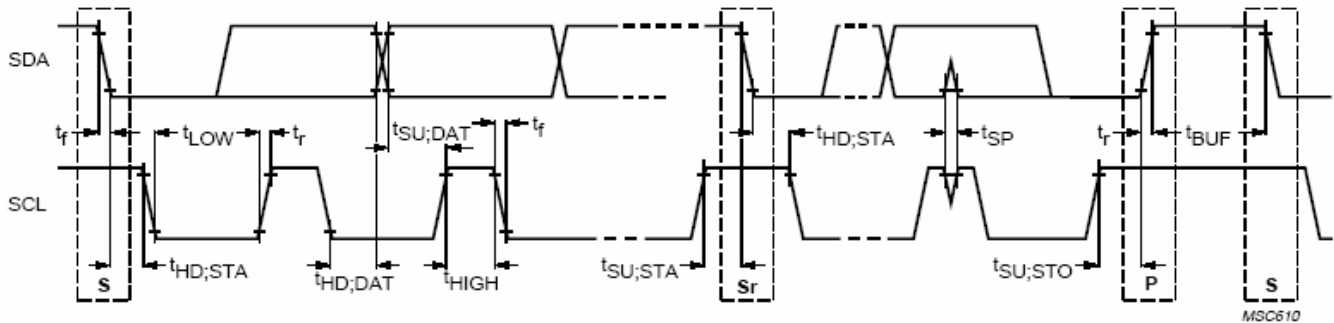


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□ I²C Timing Specification & Register Description

➤ I²C Timing Diagram



➤ I²C Timing Specification (Characteristics of the SDA and SCL bus lines)

PARAMETER	SYMBOL	STANDARD-MODE		FAST-MODE		UNIT
		MIN.	MAX.	MIN.	MAX.	
SCL clock frequency	f_{SCL}	0	100	0	400	kHz
Hold time (repeated) START condition. After this period, the first clock pulse is generated	$t_{HD;STA}$	4.0	—	0.6	—	μs
LOW period of the SCL clock	t_{LOW}	4.7	—	1.3	—	μs
HIGH period of the SCL clock	t_{HIGH}	4.0	—	0.6	—	μs
Set-up time for a repeated START condition	$t_{SU;STA}$	4.7	—	0.6	—	μs
Data hold time: for CBUS compatible masters (see NOTE, Section 10.1.3) for I ² C-bus devices	$t_{HD;DAT}$	5.0 0 ⁽²⁾	— 3.45 ⁽³⁾	— 0 ⁽²⁾	— 0.9 ⁽³⁾	μs μs
Data set-up time	$t_{SU;DAT}$	250	—	100 ⁽⁴⁾	—	ns
Rise time of both SDA and SCL signals	t_r	—	1000	$20 + 0.1C_b^{(5)}$	300	ns
Fall time of both SDA and SCL signals	t_f	—	300	$20 + 0.1C_b^{(5)}$	300	ns
Set-up time for STOP condition	$t_{SU;STO}$	4.0	—	0.6	—	μs
Bus free time between a STOP and START condition	t_{BUF}	4.7	—	1.3	—	μs
Capacitive load for each bus line	C_b	—	400	—	400	pF
Noise margin at the LOW level for each connected device (including hysteresis)	V_{nL}	$0.1V_{DD}$	—	$0.1V_{DD}$	—	V
Noise margin at the HIGH level for each connected device (including hysteresis)	V_{nH}	$0.2V_{DD}$	—	$0.2V_{DD}$	—	V

Notes

- All values referred to V_{IHmin} and V_{ILmax} levels.
- A device must internally provide a hold time of at least 300 ns for the SDA signal (referred to the V_{IHmin} of the SCL signal) to bridge the undefined region of the falling edge of SCL.
- The maximum $t_{HD;DAT}$ has only to be met if the device does not stretch the LOW period (t_{LOW}) of the SCL signal.
- A Fast-mode I²C-bus device can be used in a Standard-mode I²C-bus system, but the requirement $t_{SU;DAT} \geq 250$ ns must then be met.
This will automatically be the case if the device does not stretch the LOW period of the SCL signal.
If such a device does stretch the LOW period of the SCL signal, it must output the next data bit to the SDA line $t_{rmax} + t_{SU;DAT} = 1000 + 250 = 1250$ ns (according to the Standard-mode I²C-bus specification) before the SCL line is released.
- C_b = total capacitance of one bus line in pF. If mixed with Hs-mode devices, faster fall-times according to Table 6 are allowed.
* n/a = not applicable

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Product Specification of PDP Module

□ I²C Timing Specification & Register Description (Continued)

➤ I²C Timing Specification (Characteristics of the SDA and SCL I/O stages)

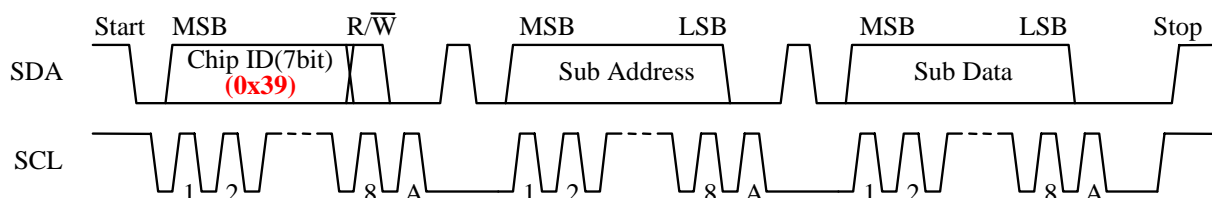
PARAMETER	SYMBOL	STANDARD-MODE		FAST-MODE		UNIT
		MIN.	MAX.	MIN.	MAX.	
LOW level input voltage: fixed input levels V _{DD} -related input levels	V _{IL}	-0.5 -0.5	1.5 0.3V _{DD}	n/a -0.5	n/a 0.3V _{DD} ⁽¹⁾	V V
HIGH level input voltage: fixed input levels V _{DD} -related input levels	V _{IH}	3.0 0.7V _{DD}	(2) (2)	n/a 0.7V _{DD} ⁽¹⁾	n/a (2)	V V
Hysteresis of Schmitt trigger inputs: V _{DD} > 2 V V _{DD} < 2 V	V _{hys}	n/a n/a	n/a n/a	0.05V _{DD} 0.1V _{DD}	— —	V V
LOW level output voltage (open drain or open collector) at 3 mA sink current: V _{DD} > 2 V V _{DD} < 2 V	V _{OL1} V _{OL3}	0 n/a	0.4 n/a	0 0	0.4 0.2V _{DD}	V V
Output fall time from V _{IHmin} to V _{ILmax} with a bus capacitance from 10 pF to 400 pF	t _{of}	—	250 ⁽⁴⁾	20 + 0.1C _b ⁽³⁾	250 ⁽⁴⁾	ns
Pulse width of spikes which must be suppressed by the input filter	t _{SP}	n/a	n/a	0	50	ns
Input current each I/O pin with an input voltage between 0.1V _{DD} and 0.9V _{DDmax}	I _i	-10	10	-10 ⁽⁵⁾	10 ⁽⁵⁾	μA
Capacitance for each I/O pin	C _i	—	10	—	10	pF

Notes

- Devices that use non-standard supply voltages which do not conform to the intended I²C-bus system levels must relate their input levels to the V_{DD} voltage to which the pull-up resistors R_p are connected.
- Maximum V_{IH} = V_{DDmax} + 0.5 V.
- C_b = capacitance of one bus line in pF.
- The maximum t_f for the SDA and SCL bus lines quoted in Table 5 (300 ns) is longer than the specified maximum t_{of} for the output stages (250 ns). This allows series protection resistors (R_s) to be connected between the SDA/SCL pins and the SDA/SCL bus lines as shown in Fig.36 without exceeding the maximum specified t_f.
- I/O pins of Fast-mode devices must not obstruct the SDA and SCL lines if V_{DD} is switched off.

※ n/a = not applicable

➤ Individual data Write/Read mode of I²C control



- ✓ Start /Stop condition is generated by Master (=Image B'D).
- ✓ Before start condition and/or after stop condition, SDA should not be recognized as a valid data.
- ✓ Start condition : SCL high & SDA transition from H to L
- ✓ Stop condition : SCL high & SDA transition from L to H

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Product Specification of PDP Module

❑ Control Signal Register Description

➤ I²C Register Brief

I ² C Addr.	I ² C Data							
	7	6	5	4	3	2	1	0
0x01	Sync Mode Registers							
	R	R	R	R	R	sync_auto	mode_sel(1:0)	
0x08	Bright Mode Registers							
	br_mode1(1:0)		br_mode2(1:0)		R		R	
0x09	Power Save Mode Registers							
	R	R	ps_mode1(2:0)			ps_mode2(2:0)		
0x0A	Power Save Mode Registers							
	R	R	R			R		
0x0B	Gamma Mode Registers							
	gamma_mode1(1:0)		gamma_mode2(1:0)		R		R	
0x10	Color Inversion Registers							
	R	R	R	R	R	R	R	Bw_inv_sw
0x11	Scroll Register							
	R	R	R	R	R	scroll_mode_sw	scroll_mode(1:0)	
0x18	ISM Mode Registers							
	R	R	R	R	R	ism_mode	1	1

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Product Specification of PDP Module

□ Control Signal Register Description (continued)

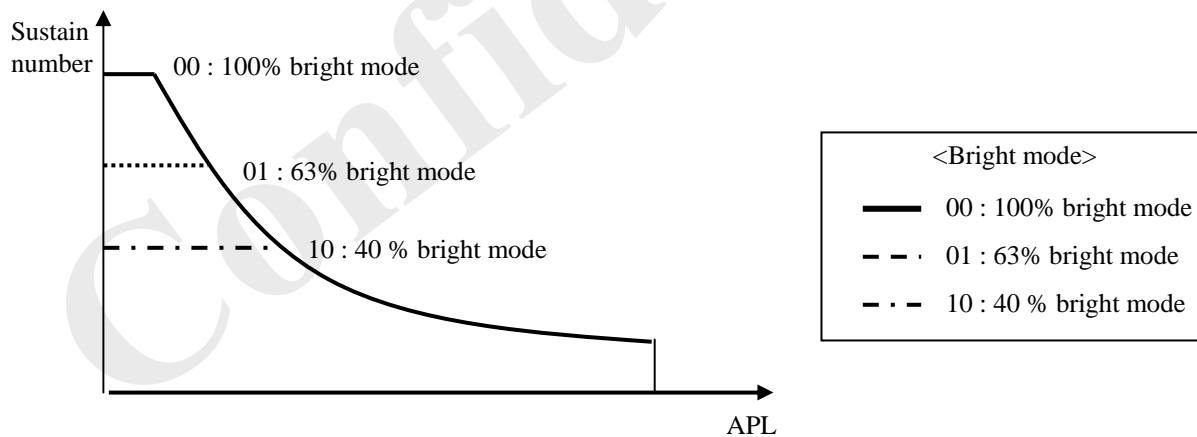
➤ Sync Mode Registers

- sync_auto : Sync automatic / manual mode selection (0>manual, 1:auto) → default : 1
- mode_sel : Mode Selection → default : 00 ※ effective only when sync_auto=0

mode_sel	Function		
00	standard mode	mode1	(50Hz)
01		mode2	(60Hz)
10	dynamic mode	mode3	(reserved)
11		mode4	(reserved)

➤ Bright Mode Registers

- br_mode_md1 : Bright mode for mode1 → default : 00
- br_mode_md2 : Bright mode for mode2 → default : 00



Power save Bright	100%	87.5%	75%	50%
100%	⊙	×	×	×
63%	×	×	⊙	×
40%	×	×	⊙	⊙

⊙ - recommended, ×- not recommended



☞ In case of “Not Recommended”, there are no problems related reliability but it may cause a flicker on the screen because of sudden change of sustain number.

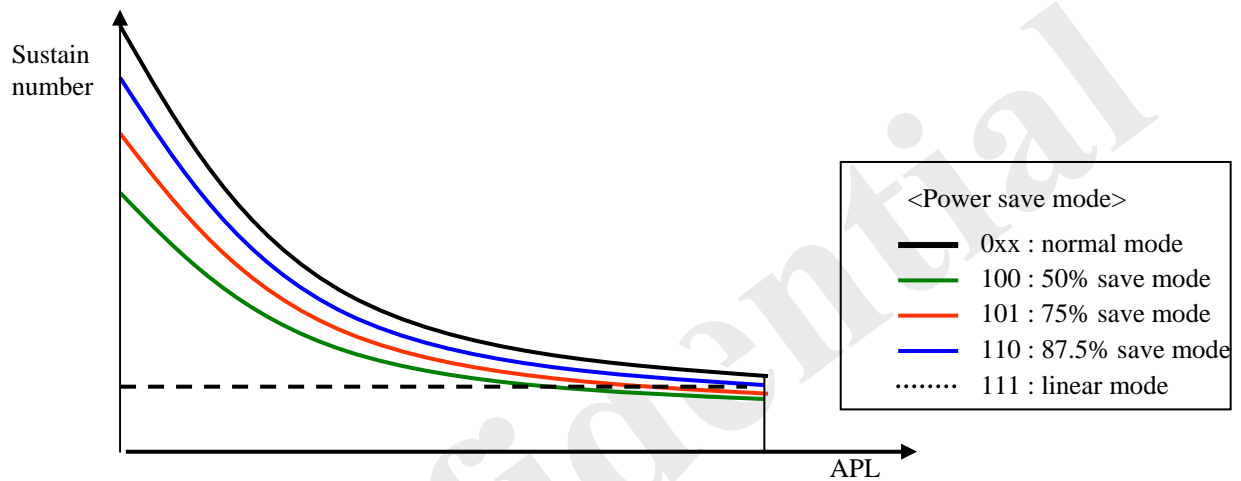
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Product Specification of PDP Module

□ Control Signal Register Description (continued)

➤ Power Save Mode Registers

- Power Save Mode : The power consumption is controlled by varying the number of sustain.
- ps_mode_md1(2:0) : Power save mode for mode 1  → default : 0xx
- ps_mode_md2(2:0) : Power save mode for mode 2  → default : 0xx



➤ Gamma Mode Registers

- gamma_md1(1:0) : Gamma mode for mode 1(50Hz) → default : 00
- gamma_md2(1:0) : Gamma mode for mode 2(60Hz) → default : 00

value	Table#	Contents of table
00	Gamma A	2.2N for R, G, B
01	Gamma B	20% Gain-up S-Curve
10	Gamma C	2.2S for R, G, B
11	Gamma D	Reserved

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Product Specification of PDP Module

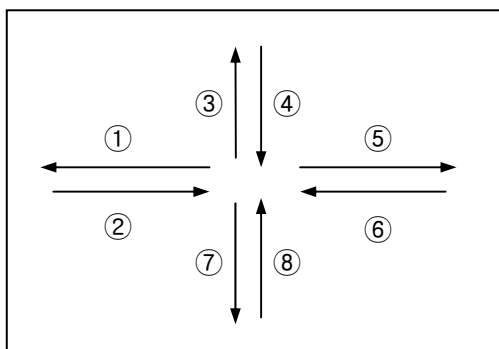
□ Control Signal Register Description (continued)

➤ Color Inversion Registers

- Image inversion enable signal for preventing image sticking.
- bw_inv_sw : picture Color Inversion (1:ON, 0:OFF) → default : 0

➤ Scroll Registers

- Picture scrolling enable signal for preventing image sticking.
 - scroll_mode_sw : Scroll mode switch (1:ON, 0:OFF)
 - scroll_mode[1] : horizontal scroll ON/OFF (1:ON, 0:OFF)
 - scroll_mode[0] : vertical scroll ON/OFF (1:ON, 0:OFF)
- default : 011



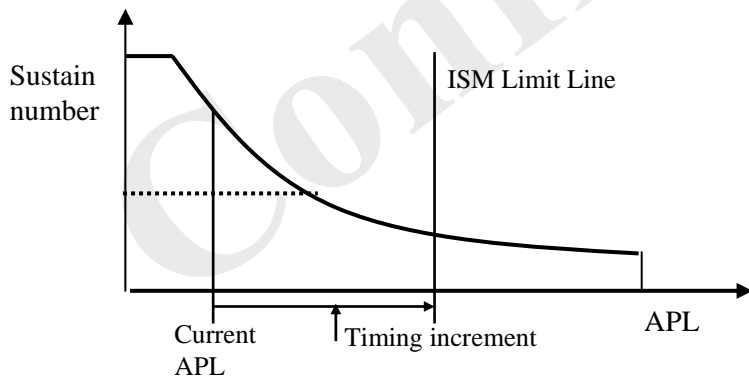
※ Scroll procedure

- ① (C→L) ② (L→C) ③ (C→U) ④ (U→C)
 ⑤ (C→R) ⑥ (R→C) ⑦ (C→D) ⑧ (D→C)
 ※ C:Center, L:Left, R:Right, U:Up, D:Down

When “scroll” is OFF during scrolling, SCROLL operation is stopped after the screen is returned to the original position(center).

➤ ISM Mode Registers

- ims_mode : ISM mode switch (1: ON, 0:OFF) → default : 1



< ISM Limit function >

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Product Specification of PDP Module

3. ELECTRO OPTICAL SPECIFICATIONS

□ Electro Optical characteristic Specifications (60Hz)

ITEM			Symbol	Condition (1)	Min	Typ	Max	Unit
Peak White Brightness*			B _{WP}	1% white window	600	1,500	-	cd/m ² (2)
Average White Brightness*			B _W	Full White	120	200	-	cd/m ²
Brightness Uniformity			B _U		-10	0	+10	%
Color Coordinate	White	X	X _W		0.270	0.310	0.350	
		Y	Y _W		0.270	0.310	0.350	
Color Coordinate Uniformity			C _U		-0.01	Average	+0.01	
Contrast Ratio*	Bright Room		CR _{BR}	100Lx at center	40:1	130:1	-	(2)
	Dark Room (3)		CR _{DR}	1% white window	2,000:1	15,000:1	-	
Viewing Angle						Free		
Power Consumption (4)			P _W	Full White	-	380	450	W

(*) This data at 50Hz is about 80% level of 60Hz data.

(*) Module brightness can be lowed up to 25% comparing with room temperature when Panel temperature is below than 18℃.

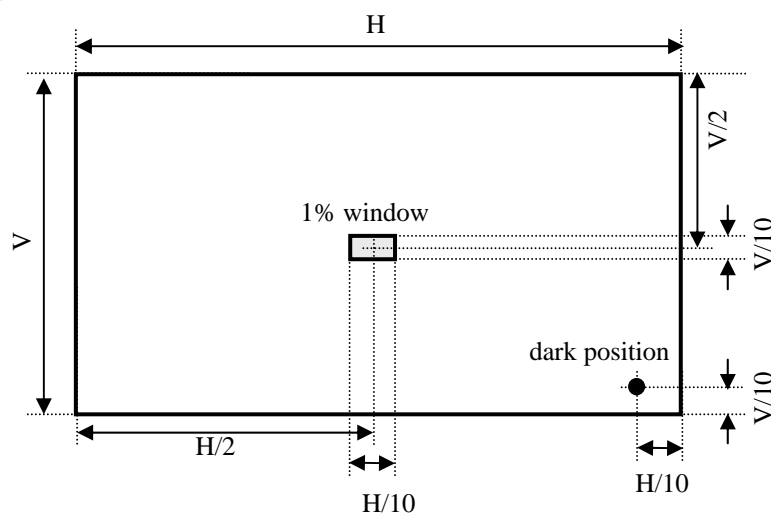
(1) All characteristics are measured in the room temperature.

(2) The brightness of the white peak position is measured while the 1%-window pattern is “ON” state. And then, it should be checked in 10 seconds after 1%-window is “ON” state.

➔ Occasionally, the dark position could be changed to any other point arbitrary.

(3) The brightness of dark room is less than 1 lux.

(4) Total Power Consumption can be up to 500W according to the displayed pattern.



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Product Specification of PDP Module

4. MECHANICAL & ENVIRONMENTAL SPECIFICATIONS

□ Mechanical Characteristic Specifications

Item		Spec.	Unit	Remark
Outline Dimensions		1,190(H) × 700(V) × 52(D) ± 1	mm	See "Outline Drawing"
Display Area		1106.5 (H) x 622.1 (V) ± 0.5	mm	
Weight	Net	20.2 ± 0.5 (1EA)	kg	
	Gross	279.2 ± 5 (12EA/1BOX)	kg	

□ Vibration and Drop Specifications

Item	Condition	Remark
Vibration	<ul style="list-style-type: none"> ▶ Direction : Y direction ▶ Acceleration : 1.25G ▶ Frequency : 5 to 55Hz ▶ Sweep time : 2 minutes ▶ Total test time : 80 minutes 	Test Object is the packing-box in which 12-modules are packed.
Drop	<ul style="list-style-type: none"> ▶ Bottom-side plane : Free Drop at 25cm height ▶ Front/Back-side plane : Inclined Drop at 25cm height ▶ Bottom-side edge : Inclined Drop at 20 cm height 	

□ Recommended Environmental Conditions

Item		Condition	
Ambient Temperature	Operation	0℃ to 40℃	
	Storage	-20℃ to 60℃	
Humidity	Operation	20 to 80% RH	No condensation
	Storage	10 to 90% RH	
Air Pressure	Operation	800 to 1,100 hPa	0~2000m above the sea level
	Storage	700 to 1,100 hPa	0~3000m above the sea level

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Product Specification of PDP Module

5. IMAGE STICKING CHARACTERISTICS

☐ Image Sticking

The fluorescent substance used in the plasma module loses its brightness with the lapse of lighting time. This deterioration in brightness appears to be a difference in brightness in relation to the surroundings, and comes to be recognized as image sticking.

In other words, the image sticking is defined as follows: when the same pattern (of the fixed display) is displayed for a long time, a difference in brightness is caused around the lighting area and non-lighting area due to deterioration in the fluorescent substance.

When the present pattern is changed over to another one, the boundary comes to be seen between the lighting area and non-lighting area due to difference in brightness in the pattern shown shortly before changeover. If this conditions is accumulated, the boundary or image sticking comes to be seen with the naked eyes.

☐ Secular change in brightness

The life of brightness, defined as the reduction to half the initial level, is more than 25 thousand hours on average.

Conditions: All white (100% white) input at an ambient temperature of 25°C.

However, this lifetime is not a guarantee value for life and brightness. It should be recognized simply as the data for reference.

☐ Warranty

Image sticking and faults in brightness and picture elements are excluded from the warranty objects.

☐ Cause of deterioration in brightness

A major possible cause of deterioration in brightness is damage in the fluorescent substance due to impact caused by ions generated at the time of plasma discharges.

☐ Practical value for Image sticking

The relationship between integrated lighting time and brightness in this plasma module is described in the attached material. In particular, the deterioration in brightness tends to be accelerated up to 100 hours in the initial period. In the initial period, the fixed display of patterns particularly tends to cause image sticking. The practical value for image sticking is difficult in concrete numerals. As described below, you are advised to take proper measures to make the occurrence of image sticking as slow as possible.

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Product Specification of PDP Module

❑ Proposed measures taken to relieve image sticking

So long as there is the reduction of brightness in the fluorescent substance, it is impossible to avoid the occurrence of image sticking. Therefore, to relieve image sticking, we offer you a method of entering an image input that may ensure reluctance to the generation of the difference in brightness reduction among the displayed dots.

The images from TV broadcasting involve a high rate of motion picture displays. Therefore, there is less chance of being a cause of difference in brightness reduction among the cells. Even when the fixed patterns are displayed, they generally last for a few minutes. Since the same pattern is less liable to be displayed, there is almost no influence toward image sticking.

If the fixed patterns tend to be displayed for a long time, however, there occurs a substantial imbalance between the lighting and non-lighting areas, thus causing a difference in brightness as a result. In this document, we offer you some proposals of installation, paying attentions to the two points: the reduction of difference in brightness achieved by integrated lighting time leveling and the method of edge smearing to make image sticking hard to be discerned.

The result from these proposals can, however, greatly depend on the contents of images and the operating environment. Therefore, we consider that it is essential to take the suitable measures in consideration of the customer's operating environment.

Example of Proposal 1: The display position is moved while the fixed display pattern is changed over, or it is scrolled during the display.

Example of Proposal 2: If possible, a pattern of complementary color is incorporated (for integrated time leveling).

Example of Proposal 3: The fixed pattern and the motion picture display are reciprocally exchanged, in order to minimize display period of the fixed pattern.

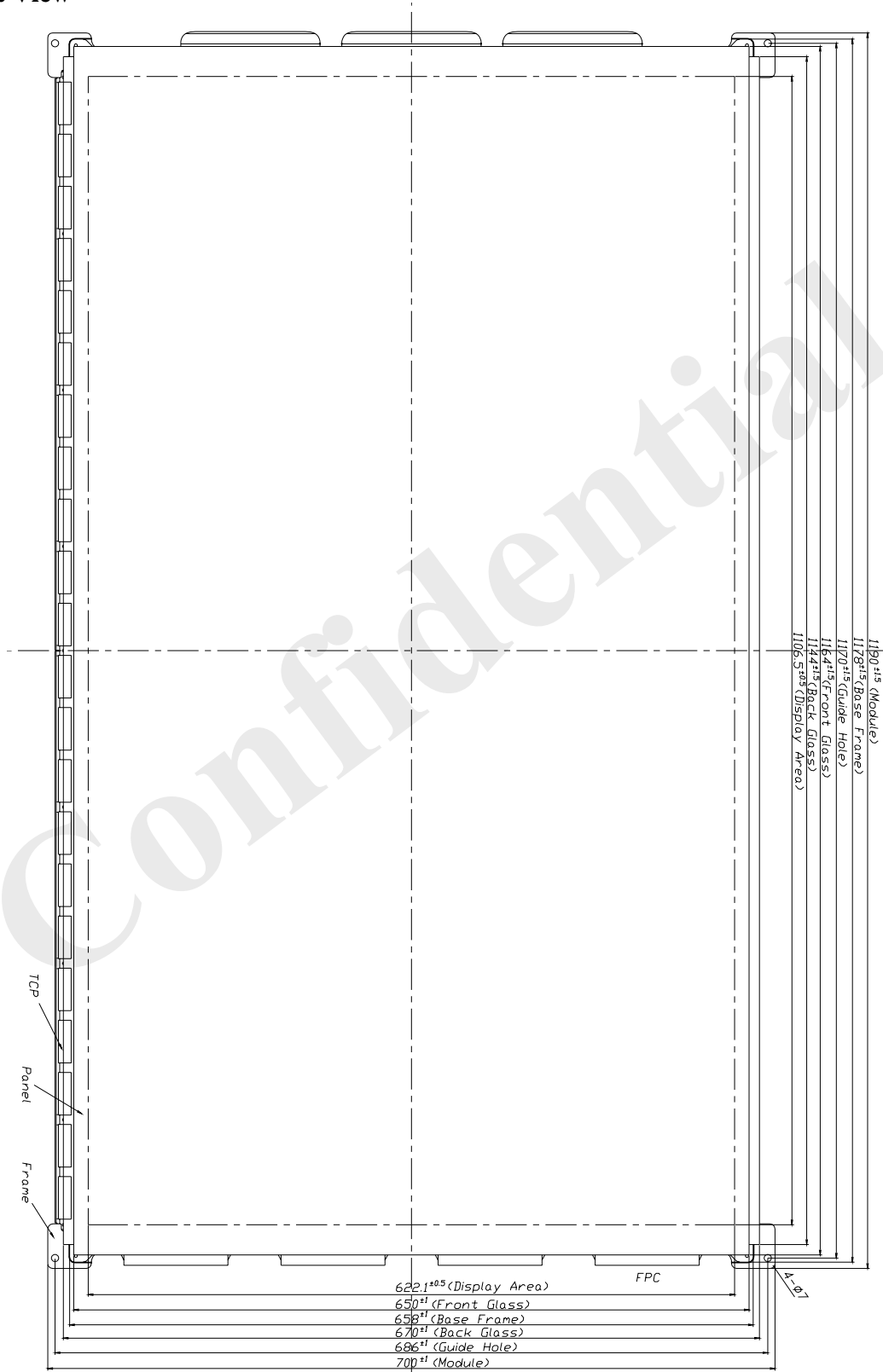
Example of Proposal 4: During operation, the brightness of screen is suppressed as low as possible. For the display patterns, characters are indicated not on the black ground (non-picture area) but on the colored ground (mixture of R, G, B recommended).

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Product Specification of PDP Module

6. OUTLINE DRAWING

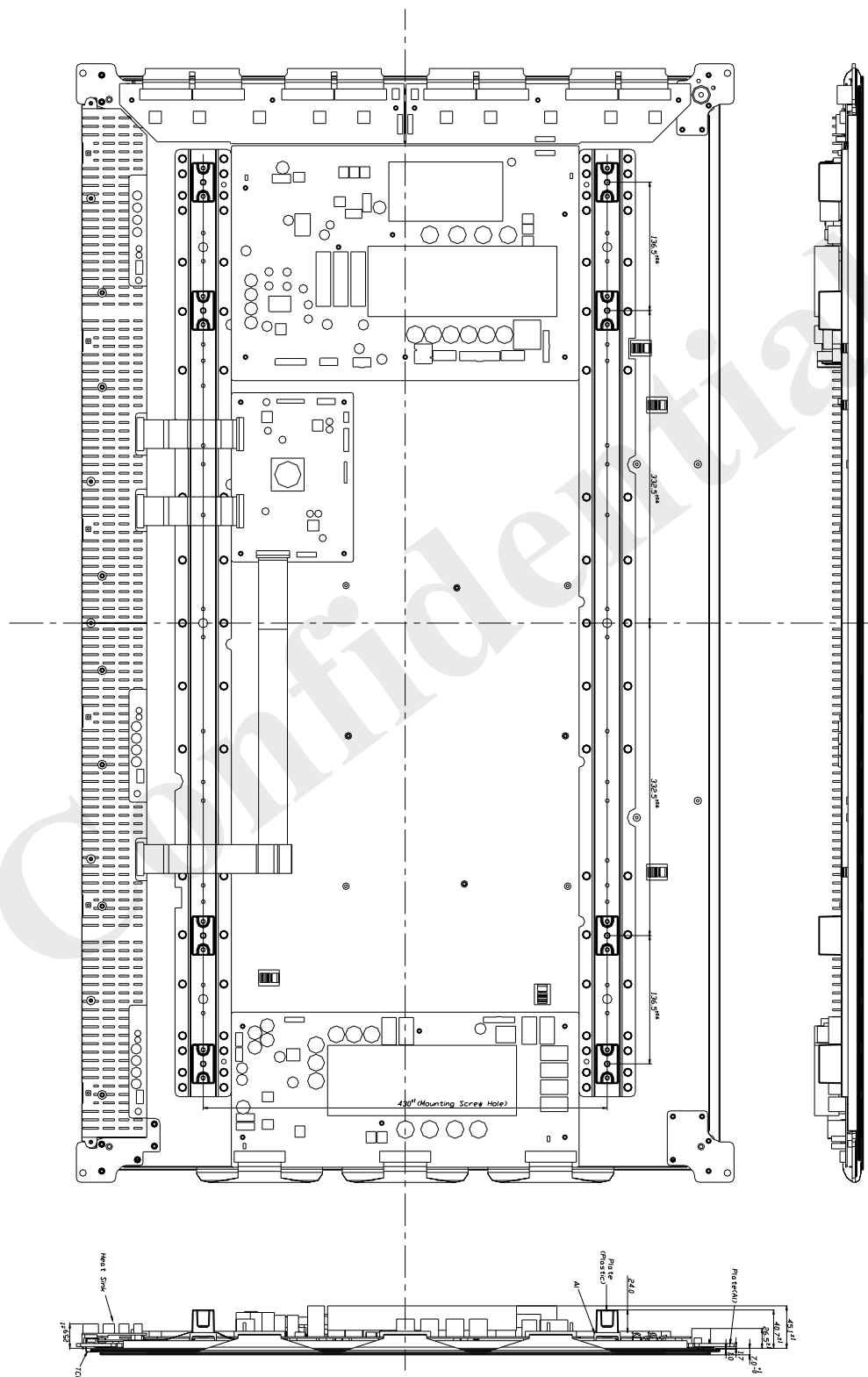
□ Front View



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Product Specification of PDP Module

❑ Rear View



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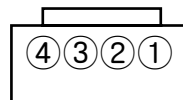
7. CONNECTORS and CONNECTIONS

□ Power Input Connector

➤ Connector P8 Pin Assignment (Y SUS Board)

Pin No.	Symbol
1	GND
2	GND
3	+5V
4	+5V

GP390-4P-TS Pin numbers
(Top View)

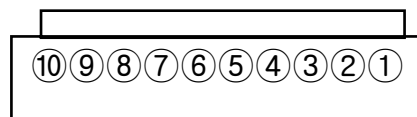


Connector : GP390-4P-TS
Housing : GP390-4S-CS
Maker : LG Cable

➤ Connector P7 Pin Assignment (Y SUS Board)

Pin No.	Symbol	Pin No.	Symbol
1	V _s	6	GND
2	V _s	7	GND
3	V _s	8	GND
4	NC	9	V _a
5	GND	10	V _a

GP390-10P-TS Pin numbers
(Top View)



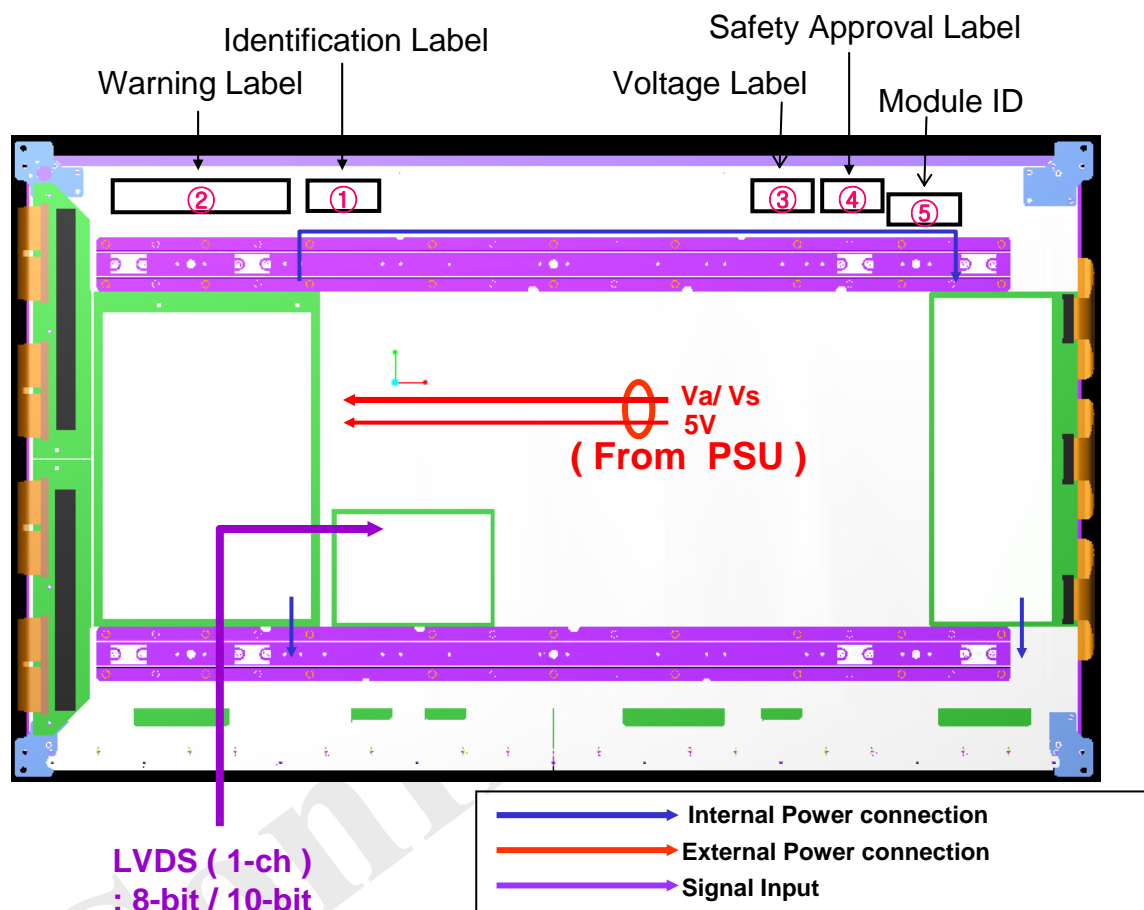
Connector : GP390-10P-TS
Housing : GP390-10S-CS
Maker : LG Cable

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Product Specification of PDP Module

8. LABEL

□ LABEL Sticking Position



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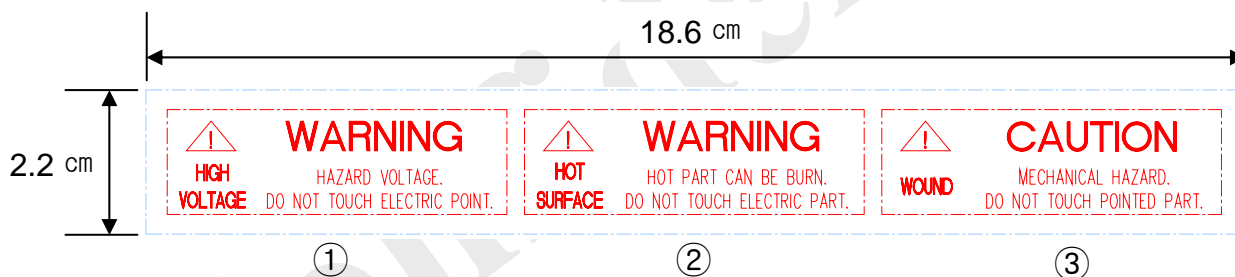
Product Specification of PDP Module

❑ Identification Label : LABEL ①



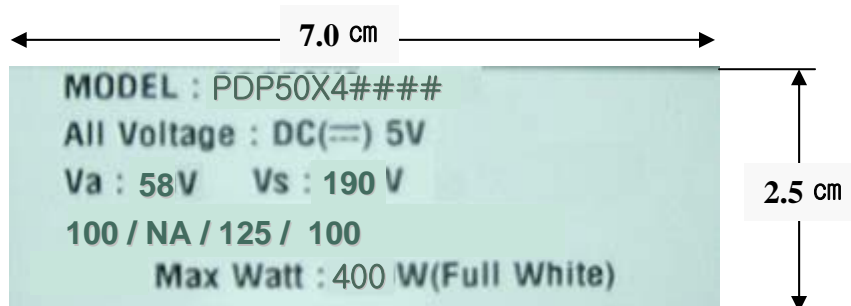
- ① Model Name
- ② Bar Code (Code 128, Contains the manufacture No.)
- ③ Manufacture No.
- ④ The trade name of LG Electronics
- ⑤ Manufactured date (Year & Month)
- ⑥ The place Origin
- ⑦ Model Suffix

❑ Warning Label Assembly (High Voltage, Hot Surface, Wound) : LABEL ②



- ① Warning (High Voltage, Hazard Voltage)
- ② Warning (Hot Surface, Hot part can be burn)
- ③ Caution (Wound, Mechanical Hazard)

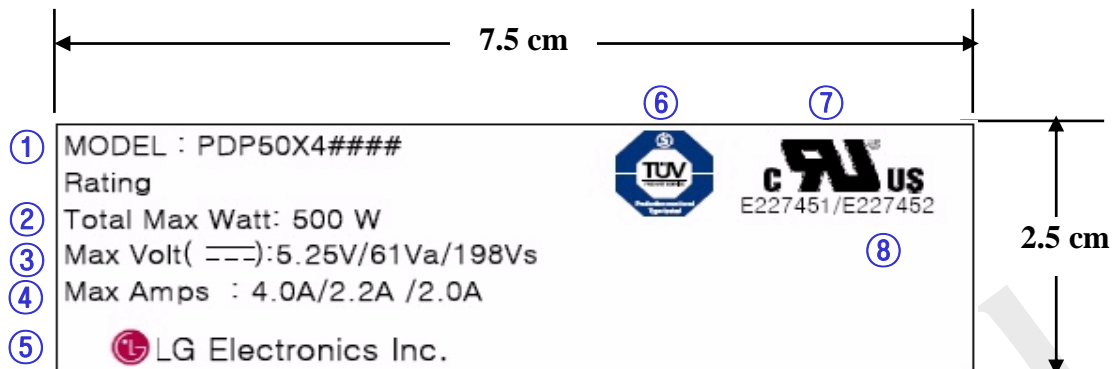
❑ Voltage Label (Model Name & Operational Voltage) : LABEL ③



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□ Safety Approval Label : LABEL ④



① Model Name

② Max. Watt (Full White)

③ Max. Volts

④ Max. Amps

⑤ The Trade Name of LG Electronics

⑥ TUV Approval Mark

⑦ UL Approval Mark

⑧ UL Approval No.

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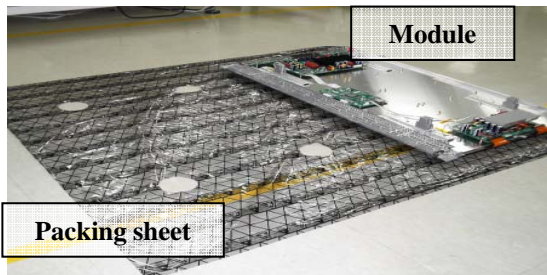
Product Specification of PDP Module

9. PACKING

□ Box packing (12 modules per each Box)

1. Prepare to Module & Packing sheet (Grid)

- Put the Module on the printed surface as four holes at the sheet locate to down of the module like the picture below.
- It has to use some supporter of 10cm height in the bottom of the module.



2. Wrapping Packing sheet

- Fold the packing sheet, align 4 holes of the sheet with support sides of the module and then tapping.
- Do not fold the right/left side of the sheet.



3. Connect Cover Plate

- Screw torque: 17~20kgf.cm
- The shape of Cover Plate is same (Top/Bottom, Right/Left)



4. Prepare bottom Box for Packing

- The arrow direction at the bottom packing Should be front side.



5. Insert wrapped modules with top packings

- Insert wrapped modules arrow direction of the bottom packing in the bottom box.
- Top packings should be inserted front side like the picture below.



6. Put Box, Tapping and Banding

- Put Box on Module(the direction of Box should be same direction as front side of Module.
- Box Tapping should be down to 10cm at right/left side like picture as shown below.
- Box banding by using the location of Banding guide.



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Product Specification of PDP Module


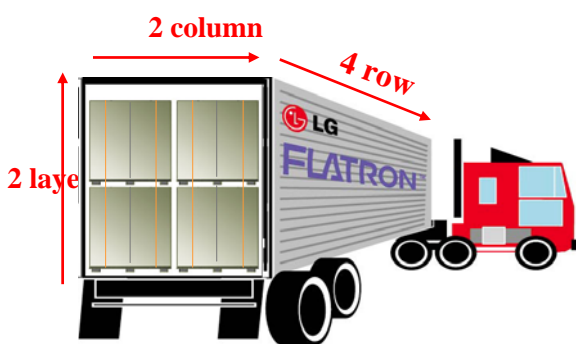
☐ Pallet Packing (1 BOX per each Pallet)



- The two boxes should be laid on the same direction.
- The banding strap should not be deviated from the indicated mark.
- The location of Banding should be within Mark (Banding guide) identified on Box.

☐ PALLET stack : 2layer loading storage

☐ Container Loading method

40 feet Container	20 feet Container
32 Pallets (32 Boxes, 384 Modules) Loading	16 Pallets (16Boxes, 192 Modules) Loading
	

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